# Development of the U.S. Integrated Earth Observation System: Progress and Recommendations for the Way Forward

*Progress Report of the U.S. Group on Earth Observations*

*March 2007*

UNITED STATES GROUP ON EARTH OBSERVATIONS

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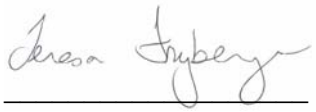
# 1. LETTER FROM THE CO-CHAIRS

As co-chairs of the U.S. Group on Earth Observations (USGEO),[1] we present the following report outlining progress in coordinating our national and international Earth observations efforts to benefit society by reducing the loss of life and property from disasters; understanding the environmental factors affecting human health; effectively manage energy resources; understand, predict, mitigate and adapt to climate variability and change; improve water management; protect and manage terrestrial, coastal and marine resources; support sustainable agriculture; and understand, monitor and conserve biodiversity. In 2005, the *ad hoc* Interagency Group on Earth Observations, now the U.S. Group on Earth Observations (USGEO), became a standing subcommittee under the National Science and Technology Council's Committee on Environment and Natural Resources. Concurrent with this designation, USGEO published the *Strategic Plan for a U.S. Integrated Earth Observation System* (IEOS) and developed an interagency structure to facilitate implementation of that plan.

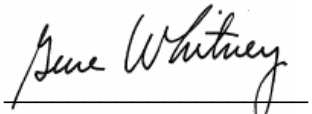
USGEO has already made progress toward realizing the goals set forth in the IEOS Strategic Plan. Its accomplishments include the development of plans for air quality, disaster reduction, and drought integrated observing systems. Implementing these near-term opportunity plans will deliver the benefits of integration to many sectors of society in a five-year timeframe with tangible results. In addition, progress has been made in identifying requirements and developing plans for data management and architecture, sea level observing, and land imaging. On the international front, USGEO continues to be a leader in and major contributor to the intergovernmental Global Earth Observation System of Systems (GEOSS).

Though USGEO has made great progress to date, we must be mindful as we move into the future that the longevity and effectiveness of USGEO and the intergovernmental Group on Earth Observations (GEO) are critically dependent on successfully transitioning from planning to implementation. USGEO will focus on meeting the IEOS goals by facilitating the implementation of all six Near-Term Opportunity plans, developing mid- and long-term opportunity plans, continue to forge successful federal collaborations, strengthening partnerships with industry and academia, and strengthening the links between USGEO and GEO.

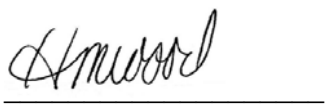
We are grateful to the many federal scientists and managers who have worked so diligently and enthusiastically on this important effort and are very encouraged by USGEO's progress. We look forward to the continued collaboration of all 15 agencies in USGEO in order to realize the full potential of our Nation's investment in Earth observations.



Teresa Fryberger, NASA



Gene Whitney, OSTP



Helen Wood, NOAA

# 2. INTRODUCTION

## 2.1 THE IDEA

On February 16, 2005, 55 countries endorsed a 10-year plan to develop and implement the Global Earth Observation System of Systems (GEOSS) for the purpose of achieving comprehensive, coordinated, and sustained observations of the Earth system. GEOSS will allow scientists and policy makers in many different countries to design, implement and operate integrated Earth observing systems in a compatible, value-enhanced way. It will link existing satellites, buoys, weather stations, and other observing instruments that are already demonstrating value around the globe and support the development of new observational capabilities where required.

The U.S. contribution to GEOSS is the Integrated Earth Observation System (IEOS). IEOS will meet our country's need for high-quality, global, sustained information on the state of the Earth as a basis for policy and decision making in every sector of our society. In many areas, observations are already being collected. In others, observational gaps will be identified and assessed to determine if their value outweighs the investment required to fill them.

## 2.2 THE CHALLENGE

Right now, thousands of individual technological instruments are gathering Earth observations around the globe. There are thousands of moored and free floating data buoys in the world's oceans, thousands of land-based environmental stations, and over 50 environmental satellites in orbit providing millions of observations. Despite advances in the availability and specificity of Earth observations, our current system of collecting, coordinating, storing, analyzing and sharing those observations is fragmented and incomplete because most of these technologies are single-use and are not integrated.

For example, due to the current lag time in receiving data (sometimes as long as 45 days), the severity of drought can be significantly under- or overestimated, placing stress on agriculture, utilities, energy, transportation, tourism, and health care systems, among others. When individual technologies are connected as one comprehensive system of systems, integrated data sets can be used to address complex interdisciplinary problems, like drought, air quality, effective disaster warnings, understanding climate variability and others.

## 2.3 THE GLOBAL EARTH OBSERVATION SYSTEM OF SYSTEMS

The United States is one of many entities spearheading development of the Global Earth Observation System of Systems (GEOSS) to meet this need for integrated, global Earth observations. GEOSS will link existing space, ocean, and terrestrial technologies that are already demonstrating value around the globe and support new observation capacities where required. It will provide a planning framework for systems, data, and vital information that will enable scientists and policy makers in many

*GEO is an organization dedicated to developing and instituting a Global Earth Observation System of Systems, or GEOSS.*

Conrad C. Lautenbacher, GEO Co-Chair for the United States, U.S. Under Secretary of Commerce for Oceans and Atmosphere

different countries to design, implement, and operate Earth observing systems in a compatible way.

This effort was launched at the first-ever global Earth Observation Summit, held on July 31, 2003, in Washington, DC. It aims to cover nine societal benefit areas: disasters, health, energy, climate, water, weather, ecosystems, agriculture, and biodiversity. Less than two years after that meeting, a 10-Year Implementation Plan outlining the intent, operating principles, and institutions relating to GEOSS was endorsed by GEO, whose membership now includes 66 countries, the European Commission, and 43 participating international organizations. For more information about GEO and GEOSS, visit http://www.earthobservations.org.

## 2.4 THE UNITED STATES INTEGRATED EARTH OBSERVATION SYSTEM


In an effort parallel to the international activities described above, fifteen Federal agencies, with primary leadership from the National Oceanic and Atmospheric Administration (NOAA), the National Aeronautics and Space Administration (NASA), and the White House Office of Science and Technology Policy (OSTP), are planning for a national Integrated Earth Observation System (IEOS) under the auspices of the U.S. Group on Earth Observations (USGEO). They published the *Strategic Plan for the U.S. Integrated Earth Observation System* (available online at http://usgeo.gov/docs/EOCStrategic_Plan.pdf) in April 2005. This plan sets forth the goals and requirements for U.S. observing systems and contributions to GEOSS. Further, it offers a vision for enabling a healthy public, economy, and planet through an integrated, comprehensive, and sustained Earth observation system. Consistent with the strategic plan, USGEO focused activity in three areas this year:

- Identified and developed near-term opportunities that provide a framework for prioritizing actions and addressing critical Earth observation gaps;
- Expanded existing governmental partnerships at all levels and developed new long-term partnerships with industry, academia, non-governmental organizations, and international organizations; and
- Participated in the work of GEO on the development of GEOSS.

# 3. PROGRESS

## 3.1 NEAR-TERM OPPORTUNITY PLANS DEVELOPED

Near-term opportunities identified in the *Strategic Plan for the U.S. Integrated Earth Observation System* highlight five observing systems and an initiative in architecture and data management that meet high priority national needs, are compatible with agency missions, can be implemented within five years, benefit society in multiple ways, and have easily-identified, tangible results. The following near-term opportunity plans provide a framework for prioritizing actions and addressing critical gaps that will maximize the return on investment:

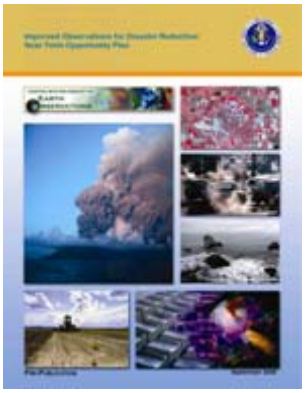
- Architecture and Data Management (in development);
- Improved Observations for Disaster Reduction (published September 2006);
- National Integrated Drought Information System (published September 2006);
- Air Quality Assessment and Forecast System (published September 2006);
- Global Land Observation System (in development); and
- Sea Level Observation System (in development).

*Global earth observations support research in a wide range of sciences important for society. The U.S. Strategic Plan for an Integrated Earth Observations System provides guidance for agencies contributing to these efforts and establishes six Near-Term Opportunities that serve as the focal point of U.S. R&D activities. Agencies are encouraged to align their R&D programs in this area with the recommendations in the U.S Group on Earth Observations' annual report, Development of the U.S. Integrated Earth Observations System: Progress and Recommendations for the Way Forward.*

Office of Management and Budget/Office of Science and Technology Policy FY 2008 Administration Research and Development Budget Priorities Memo

By developing the plans described below, USGEO is recommending priorities for investment, including new requirements, and establishing U.S. policies for Earth observations and data management. These goals are identified in the IEOS Strategic Plan and emphasized in the Office of Management and Budget/Office of Science and Technology Policy FY 2008 Administration Research and Development Budget Priorities Memo.

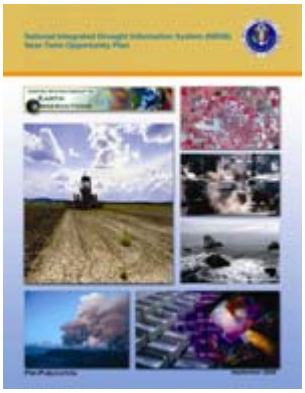
**Architecture and Data Management.** A comprehensive and integrated data management and communications strategy to effectively integrate the wide variety of Earth observations across disciplines, institutions, and temporal and spatial scales is needed. Data management is a key enabler for the mission-oriented near-term opportunities described above as well as for all other benefits of Earth observations. USGEO is building a conceptual architecture of principles and guidelines for data management that will be available in 2007.



**Improved Observations for Disaster Reduction.** To fully realize the benefits gained from the observation systems, information must be disseminated through effective warning systems and networks with products tailored to the needs of the end users and the public. In order to emphasize the need for Earth observation systems that fit within an integrated, end-to-end, disaster reduction framework, the *Improved Observations*

*for Disaster Reduction Near-Term Opportunity Plan* focuses on multi-hazard demonstration projects for two high-risk regions: the Pacific states and the Gulf of Mexico coast. These projects are a means to show rapid progress with modest investments, thereby demonstrating proof of concept with benchmarks for success in areas vulnerable to catastrophic natural hazard events.

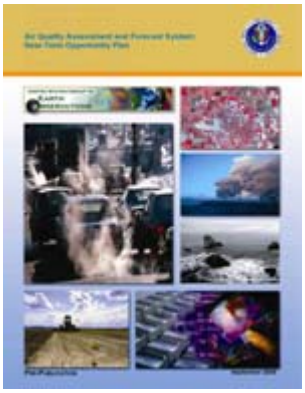
Societal benefits in the disasters and weather areas realized from these successful demonstration projects include real-time earthquake information delivery for targeting rapid emergency response; improved tsunami and coastal inundation forecast and warning capabilities; safer aviation travel due to rapid detection of volcanic eruptions; and a prototype early warning system for debris flows and landslides in wildfire-impacted areas. In addition to the multi-hazard demonstration projects, the plan emphasizes the need for integrated earthquake and coastal inundation observation systems to close key gaps nationwide in ground-based monitoring networks and high-resolution digital topography to provide all-weather day/night imaging, monitor surface deformation, and determine inundation extent.



**National Integrated Drought Information System.** To adequately address drought disasters, in 2004 the Western Governors' Association (WGA) formed a task force and produced *Creating a Drought Early Warning System for the 21st Century – The National Integrated Drought Information System (NIDIS).*[2] The *NIDIS Near-Term Opportunity Plan* builds on the business requirements outlined in the WGA document and focuses on critical gaps that can be quickly and effectively closed, including:

- Improved drought monitoring, assessment, and prediction through observational frequency, timeliness, and density of essential environmental variables already in place;
- A U.S. drought portal that gives the NIDIS user communities the ability to easily integrate drought related data and information across Federal, state, local agencies, and non-Federal entities;
- A NIDIS operations office to coordinate the development, implementation, and maintenance of NIDIS-related work inside and outside the Federal agencies.

It benefits society in all areas: disasters, health, energy, climate, water, weather, ecosystems, agriculture and biodiversity.



**Air Quality Assessment and Forecast System.** Technical and scientific advancements, including new observing and information technologies and insights into atmospheric processes, have created opportunities to effectively address air quality issues. The *Air Quality Assessment and Forecast System Near-Term Opportunity Plan* identifies several areas where agencies can leverage existing and planned systems to develop integrated data and modeling products and services, including routine production of air quality fields that integrate information

from multiple types of observing systems and from models. The plan also proposes pursuing approaches for assimilating air quality observations into models that will enable air quality decision-makers and planners to more effectively prevent future problems while also maintaining a vital economy. In addition, air quality forecasters will be able to issue more accurate warnings and alerts to initiate community actions. This will reduce the severity of episodes of poor air quality and personal actions and reduce adverse health effects. This plan's products and services also provide secondary benefits to most societal benefit areas including improvements to weather forecasting and understanding climate change, more effective management of agriculture and energy sectors, and better protection of oceans and ecosystems.

**Global Land Observation System.** Land observations, particularly space-based, moderate resolution data, such as those provided by the Landsat satellites, are used by government, commercial, industrial, civilian, military, and educational communities throughout the United States and around the world. Among other societal benefits, these reduce life and property losses from disasters and increase understanding the impact of environmental factors on human health. These types of data provide a historical record of land-use change and the impact of natural and anthropogenic events. The thirty-four year archive of global Landsat observations is an invaluable record for the scientific community, providing insight into the relationship between land cover/land use change and global climate change, and to the broader applications community.

USGEO is leading the effort to develop a long-term plan to achieve technical, financial, and managerial stability for operational, moderate resolution land imaging in accord with the goals and objectives of the U.S. Integrated Earth Observation System. The plan will be available in February 2007. (See text box.)

USGEO is supporting activities that will extend the use and enhance the benefits of moderate resolution observations from space. These activities include the acquisition and distribution of a mid-decadal global, orthorectified satellite-image data set derived primarily from Landsat data with other land-imaging satellites; the development of a prototype, moderate resolution, land cover database; and the land cover database for an agricultural land mask at 30m resolution. The mid-decadal, global data set will provide a baseline for measuring change when compared to a similar data set derived from Landsat 7 data in 2000. Completion of a global land cover product is a multi-year effort.

*It remains the goal of the U.S. Government to transition the Landsat program from a series of independently planned missions to a sustained operational program funded and managed by a U.S. Government operational agency or agencies, international consortium, and/or commercial partnership. Concurrent with the actions cited above, the National Science and Technology Council, in coordination with NASA, DOI/USGS, and other agencies and EOP offices as appropriate, will lead an effort to develop a long-term plan to achieve technical, financial, and managerial stability for operational land imaging in accord with the goals and objectives of the U.S. Integrated Earth Observation System.*

Dr. John H. Marburger, III, Director, White House Office of Science and Technology Policy on December 23, 2005

The near term activity will focus first on the U.S. development of an agricultural land mask. The classification and the agricultural land mask can serve as the models for extending the products worldwide. As part of these tasks, the participants in the global land observation system will seek to improve access to existing moderate resolution data sets and the new data sets that emerge from USGEO actions in 2007.

**Sea Level Observation System.** An integrated sea level observation system will provide accurate and timely observations of sea-level variability critical for forecasting and mitigating natural hazards as well as monitoring and understanding sea level and climate variability at global and regional scales. Further, the observing system coupled with a robust modeling strategy will provide information on all known contributors to sea level change, i.e. ocean thermal expansion and contraction, glacier and ice sheet growth and shrinkage, terrestrial impoundment of water, and movement (uplift and subsidence) of land in coastal regions. That information is all part of a larger ocean observation strategy. In collaboration with National Science and Technology Council Committees and Subcommittees, the Climate Change Science Program and the Interagency Committee on Ocean Science and Resource Management Integration, USGEO will provide an ocean observation plan in 2007.

## 3.2 ENGAGING STAKEHOLDERS

To realize the IEOS Strategic Plan goals, this year USGEO expanded existing governmental partnerships at all levels and developed new long-term partnerships with industry, academia, and non-governmental and international organizations. A partial listing of those diverse endeavors is below.

**Workshop on Integrated Earth Observations: Applications to Air Quality and Human Health.** On August 1-2, 2005, the National Institute of Environmental Health Sciences and the Environmental Protection Agency brought together data producers, data organizers, and data users to identify Earth observation data and data products related to air quality and climate that could be used effectively in public health research, planning, and decision making.

**Public Engagement Workshop.** During a public workshop, held on May 9-10, 2005, in Washington, DC, 360 representatives from industry, academia, nongovernmental organizations, and Federal agencies provided input on ways to move toward implementation of the nine societal benefit areas and the six Near-Term Opportunities outlined in the Strategic Plan. Workshop participants represented a range of sectors, including research, agriculture, energy, public health, conservation, information technology, transportation, and data integration. The workshop provided a forum for cross-sector, multidisciplinary input on the implementation of the Strategic Plan and further aided in the development of the near-term opportunity planning.

**Integrated Ocean Observing System Implementation Conference.** The second Integrated Ocean Observing System (IOOS) Implementation Conference in May 2005 focused on multi-hazard forecasting relating to coastal inundation. IOOS is a system of systems that routinely and continuously provides quality-controlled data and information

on current and future conditions of the oceans and Great Lakes. This scope of this information ranges from global (e.g., ocean basins) to local (e.g., coastal ecosystems). IOOS is the oceans and coasts component of the IEOS, the U.S. contribution to the Global Ocean Observing System, and the U.S. contribution to the oceans and coasts component of GEOSS.

**International Workshop on Seismological Networks and GEOSS.** In August 2005, the U.S. Geological Survey, National Science Foundation, and IRIS Consortium co-sponsored an International Workshop on the Utilization of Seismographic Networks within GEOSS in Washington, DC. Participants included more than 50 delegates from 14 nations, representing a broad spectrum of disciplines, scientific agencies, and networks. The workshop focused on network, data, and products—topics emphasized in the GEOSS Implementation Plan—with each topic focused on canvassing existing capabilities, exploring synergies catalyzed by open international sharing, and enhancing the role of diverse scientific disciplines to GEOSS.

**Earth Observation System Architecture Workshop: Enabling an Entrepreneurial Environment.** A technical architecture approach for the IEOS with appropriate linkages to GEOSS was developed through this USGEO-sponsored workshop held on October 27-28, 2005, in Washington, DC. The workshop involved 65 representatives from industry, academia, nongovernmental organizations, and Federal agencies with expertise in information technology, data management, and enterprise architecture. USGEO provided updates on IEOS, GEOSS, the current approach to the architectures of IEOS and GEOSS, and the national Geospatial Profile of the Federal Enterprise Architecture. (For more information on the Federal Enterprise Architecture, see http://www.whitehouse.gov/omb/egov/a-1-fea.html.) This workshop provided USGEO with private sector input for evaluating the next steps to leverage efforts in spatially enabled search portals, geo-referenced emergency alerting, modeling and data assimilation, and decision support tools.

**Forum on Earth Observations: Managing Risk in the 21st Century.** This two-day USGEO-sponsored forum in La Jolla, California on February 15-16, 2006, convened business, academic, non-government, and government leaders to address key issues in the planning and implementation of a global Earth observation system. Members of the private and public sectors learned about the latest developments in Earth observation efforts, examined the needs and interests of both sectors, and discussed the types of business models that enable an entrepreneurial environment.

**IEEE International Geoscience and Remote Sensing Symposium: Remote Sensing – A Natural Global Partnership.** Reflecting the interconnected nature of understanding and managing the global environment, this five-day forum held in Denver, Colorado on July 31 - August 4, 2006, brought together industry, government, and academia to discuss user applications of remotely sensed data.

**Biodiversity and Human Health: A Multidisciplinary Approach to Examining the Links.** This forum of the U.S. Environmental Protection Agency was co-sponsored by

Yale's Center for EcoEpidemiology, the Smithsonian Institution, and the World Conservation Union and is part of a series on contemporary issues related to environment and health sponsored by the Yale Institute for Biospheric Studies, Center for EcoEpidemiology. The forum, held on September 14, 2006, was coordinated internationally through GEO in cooperation with the European Commission, Canada, Uruguay, and Brazil.

### 3.3 INTERNATIONAL CONTRIBUTIONS

The United States continues to actively participate in GEO on the development of GEOSS. Throughout 2005 and 2006, USGEO coordinated and formulated the U.S. contributions to the development of international documents that have had major impacts on the continued development of GEOSS, including the GEO Rules of Procedure, Terms of Reference for Committees and Working Groups, and GEO multi-year work plan with more than 70 individual tasks. USGEO members have provided strong leadership to the Group on Earth Observations Committees (Architecture and Data Management, Capacity Building, Science and Technology, and User Interface) and the Working Group on Tsunami Activities. These GEO organizations address the necessary aspects of GEOSS implementation. This leadership is guided by the principles of the 96 Task Groups from the 2006 GEO Work Plan. Some results of this leadership are:

- Significant progress toward attaining the vision of a fully operational GEONetCast;
- A development process by which members and participating organizations contribute their components (necessary data building blocks of GEO);
- Obtaining hosting proposals for component, service, and interoperability registries that allow GEO members and participating organizations to discover, access, and share data and information that enable societal benefits.

These accomplishments will be briefed to the GEO Plenary, which meets in Bonn, Germany in late November 2006, for discussion and adoption.

**GEONETCast**

GEONETCast is an information dissemination system under development by which environmental remotely-sensed and *in situ* data and products will be transmitted to users through communication satellites using standard (or widely available) broadcast capabilities. It is anticipated that this capability would be especially useful in parts of the world where high-speed internet access is expensive or not available.

Also, USGEO coordinates U.S. participation in the development and outcome of GEO meetings[3] and contributes to coordination with existing efforts and systems, on which GEOSS is being built. In particular, the United States, through the USGEO, works to enhance interactions and to explore mechanisms

for harmonization of GEO activities with the Committee on Earth Observation Satellites (CEOS), Integrated Global Observing Strategy-Partners (IGOS-P), Global Climate Observing System (GCOS) Steering Committee, World Climate Research Program (WCRP), International Geosphere-Biosphere Programme (IGBP), and Global Biodiversity Information Facility (GBIF).

# 4. RECOMMENDATIONS FOR THE WAY FORWARD

It is clear from the progress of these past three years, that the ideas behind GEOSS and IEOS have struck a cord in the scientific community, industry, and the governments of 66 countries. In a short period of time, 15 domestic Federal agencies have begun collaborating in much the same way as those 66 countries internationally. Governance structures, strategic plans, and implementation plans also have been developed, but the real work has just begun. GEOSS and IEOS are at a critical transition point—those involved must now move beyond the promotion and planning stages and begin the difficult work of implementation. The longevity and effectiveness of USGEO and the intergovernmental GEO are critically dependent on this successful transition. Recommendations for near-term activities will ensure success in making this transition and lead to an effective and enduring IEOS and GEOSS follow:

**Enhance Links Between USGEO and Intergovernmental GEO Activities.** The United States is committed to the intergovernmental GEO effort, the tasks on which it will contribute and the tasks on which it will lead. USGEO, through the U.S. representatives on the Architecture and Data Management, User Interface, Capacity Building, and Science and Technology Committees, will track these tasks to see that they are accomplished in context of the mission and on time.

**Strengthen USGEO Governance Structure.** Improved observations has been identified as a top priority by nearly every sector of the environmental research community in recent years. Meeting this need and achieving the ambitious goals of IEOS will require increased support for USGEO interagency coordination activities. An Earth observations program coordination office may be established and supported by the agencies on a cooperative basis to support observations and associated needs across the NSTC Committee on Environment and Natural Resources.

**Strengthen Private Sector Partnerships.** USGEO will build stronger links to the academic and industrial sectors by creating formal processes for obtaining private sector input. Stronger partnerships to industry will ensure that USGEO utilizes and leverages the latest capabilities in such areas as spatially-enabled search portals, geo-referenced emergency alerting, modeling and data assimilation, and decision support tools. Likewise, stronger ties to the academic community will ensure that:

- The best available science and technology is utilized in implementing the U.S. Integrated Earth Observation Strategic Plan;
- Research community needs are incorporated in USGEO plans and implementation actions; and
- The scientific community is poised to take advantage of new information available from observation integration for research and model development.

**Forge Successful Federal Collaborations.** USGEO will strengthen its role in coordinating efforts focused on observations, particularly in support of climate change

and oceans research and development. Observing systems in these areas are being planned through the U.S. Climate Change Science Program (CCSP) and the Interagency Committee on Ocean Science and Resource Management Integration (ICOSRMI). The CCSP Observation Interagency Working Group is developing a process to define and evolve rigorous climate observing system requirements through regularly updated Earth system reanalysis, metrics for GEOSS that incorporate climate observing principles, continued development of decision support tools, and improved mechanisms to transmit user feedback to the climate observing system.

At the direction of the U.S. Ocean Action Plan, the NSTC Joint Subcommittee for Oceans Science and Technology (JSOST) is currently drafting the Ocean Research Priorities Plan, which will determine the Nation's ocean research priorities for the next ten years. It is anticipated that ocean observations will be one of a few top priorities that this plan addresses.

Given the importance and broad implications of these systems, it is imperative that USGEO play a support their development. USGEO will collaborate with other NSTC subcommittees to identify observation needs and requirements, support and promote the implementation of these systems, and assess how these systems or components of these systems should be integrated with and incorporated into other observing systems to ensure optimum use of observations.

**Facilitate Stronger Links Between *In Situ* and Remote Sensing Observations.** To address specific, high priority scientific questions across disciplines and at the appropriate local, state, regional, continental and global scales, USGEO will coordinate with 17 Federal agencies and work with GEO members to optimize the links between *in situ* and satellite observations to achieve credible forecasting and prediction benefiting all areas of society.

**Promote Agency Collaboration for Effective Data Management.** Effective data management is the keystone of an effective earth observations system. New observation systems coming online will yield a 100-fold increase in the amount of Earth observation data at a time when individual agencies' data management systems are challenged to adequately process current data streams. USGEO will produce a conceptual architecture of principles and guidelines for data management that will be available in 2007. Further, agencies are strongly encouraged to collaborate and upgrade or produce data management systems that are well-linked to support the full information cycle from observation acquisition to information delivery. Consistent with the IEOS Strategic Plan,

> *Data products will be made readily available and easily accessible by applying data management systems. This activity will include standardizing vocabularies across agencies and developing browsing and visualization systems. Interoperability is achieved through protocols and standards agreed upon by the member agencies. These tools will enable users to effectively locate data and information relevant to their needs.*

# APPENDIX A: REFERENCES

[1] A subcommittee reporting to the National Science and Technology Council (NSTC) Committee on Environment and Natural Resources (CENR)

[2] http://www/westgov.org/wga/publicat/NIDIS.pdf

[3] http://www.earthobservations.org/meetings/meetings.html

# APPENDIX B: ABOUT THE U.S. GROUP ON EARTH OBSERVATIONS (USGEO)

The United States Group on Earth Observations (USGEO) was established in March 2005 as a standing subcommittee of the National Science and Technology Council Committee on Environment and Natural Resources. Primary goals of the subcommittee are:

- To continue development and coordination of the U.S. Integrated Earth Observation System (IEOS), and
- To formulate the U.S. position and coordinate participation in the intergovernmental Group on Earth Observations (GEO) as formed at the third Earth Observation Summit on February 16, 2005.

The USGEO is co-chaired by Teresa Fryberger (OSTP), Bryant Kramer (NASA), and Greg Withee (NOAA). The USGEO comprises representatives from 15 member agencies and three White House offices:

- Department of Agriculture
- Department of Commerce
- Department of Defense
- Department of Energy
- Department of Health and Human Services
- Department of Homeland Security
- Department of Interior
- Department of State
- Department of Transportation
- Environmental Protection Agency
- National Aeronautics and Space Administration
- National Science Foundation
- Smithsonian Institution
- Tennessee Valley Authority
- U.S. Agency for International Development
- White House Council on Environmental Quality
- White House Office of Management and Budget
- White House Office of Science and Technology Policy

USGEO working groups include:

- Architecture Management
- Capacity Building and Outreach
- Science and Technology
- User Interface

### ABOUT THE NATIONAL SCIENCE AND TECHNOLOGY COUNCIL

The National Science and Technology Council (NSTC), a cabinet level council, is the principal means for the President to coordinate science and technology policies across the Federal Government. NSTC acts as a “virtual” agency for science and technology to coordinate the diverse parts of the Federal research and development enterprise.

An important objective of the NSTC is the establishment of clear national goals for Federal science and technology investments in areas ranging from information technologies and health research to improving transportation systems and strengthening fundamental research. This council prepares research and development strategies that are coordinated across Federal agencies to form an investment package that is aimed at accomplishing multiple national goals. To obtain additional information regarding the NSTC, visit www.ostp.gov.

## ABOUT THE OFFICE OF SCIENCE AND TECHNOLOGY POLICY

Congress established OSTP in 1976 with a broad mandate to advise the President and others within the Executive Office of the President on the impacts of science and technology on domestic and international affairs. The 1976 Act also authorizes OSTP to lead an interagency effort to develop and to implement sound science and technology policies and budgets and to work with the private sector, state and local governments, the science and higher education communities, and other nations toward this end. The Director of OSTP serves as co-chair of the President's Council of Advisors on Science and Technology and oversees the National Science and Technology Council on behalf of the President. For more information, visit www.ostp.gov.

# APPENDIX C: ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| ANSS | Advanced National Seismic System |
| CAM | Constructed Area Mapping |
| CCSP | U.S. Climate Change Science Program |
| CENR | Committee on Environment and Natural Resources |
| CEOS | Committee on Earth Observation Satellites |
| DoD | Department of Defense |
| DOI | Department of the Interior |
| EOP | Executive Office of the President |
| EPA | Environmental Protection Agency |
| EUMETSAT | European Organisation for the Exploitation of Meteorological Satellites |
| FAA | Federal Aviation Administration |
| FAS | Foreign Agricultural Service |
| FEA | Federal Enterprise Architecture |
| FEMA | Federal Emergency Management Agency |
| GBIF | Global Biodiversity Information Facility |
| GCOS | Global Climate Observing System |
| GEO | Group on Earth Observations (international) |
| GEOSS | Global Earth Observation System of Systems (intergovernmental) |
| GITAN | Global Integrated Trends Analysis Network |
| GLAM | Global Agricultural Monitoring |
| GLOS | Global Land Observation System |
| GPS | Global Positioning System |
| GRACE | Gravity Recovery and Climate Experiment |
| ICESat | Ice, Cloud, and land Elevation Satellite |
| IEOS | Integrated Earth Observation System (national) |
| IGBP | International Geosphere Biosphere Programme |
| IGOS-P | Integrated Global Observing Strategy-Partners |
| InSAR | Interferometric Synthetic Aperture Radar |
| IOOS | Integrated Ocean Observing System |
| IPCC | Intergovernmental Panel on Climate Change |
| IWGOO | Interagency Working Group on Ocean Observations |
| LIDAR | Light Detection and Ranging |
| NASA | National Aeronautics and Space Administration |
| NIDIS | National Integrated Drought Information System |
| NOAA | National Oceanic and Atmospheric Administration |
| NSTC | National Science and Technology Council |
| NTO | Near Term Opportunity |
| NWLON | National Water Level Observation Network |
| OMB | Office of Management and Budget |
| OSTP | Office of Science and Technology Policy |
| SAR | Synthetic Aperture Radar |
| SDR | Subcommittee on Disaster Reduction |
| SLR | Satellite Laser Ranging |
| TOPEX | Ocean Topography Experiment |
| UAV | Unmanned Aerial Vehicle |

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| USAID | United States Agency for International Development |
| USDA | United States Department of Agriculture |
| USGEO | United States Group on Earth Observations |
| USGS | United States Geological Survey |
| VLBI | Very Long Baseline Interferometry |
| WCRP | World Climate Research Program |
| WGA | Western Governors' Association |


**National Science and Technology Council**

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